WOA-01751

Naval Research Labs

Title **CAL Mass Properties Measurement - Weighing Operations, FM106**

Module Serial Num: **106** | Activity Level: **Flight** | System: **CAL Module**

Originator:

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Assigned To:

Name: **Lisa Gelston**
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Phone: **202-404-7193**

Support:

- [x] **QA Final Inspection?**
- [ ] **Safety?**
- [x] **Photo?**
- [ ] **Logistics?**

Managers & Approvals

APPROVAL SIGNATURES:	SIGNATURE	APPVD	INITIALS	DATE
I&T MANAGER:	Eric Grove	☑	EG	12/20/2004
MECHANCIAL MANAGER:	Paul Dizon	☑	PD	12/17/2004
ELECTRICAL MANAGER:	Not Required	☐		
SYSTEMS MANAGER:	William Raynor	☑	BR	12/20/2004
QUALITY MANAGER:	Lamont Franklin	☑	LM	12/17/2004
OTHER:	Not Required	☐		

Date Opened: **12/17/2004** | Date Submitted: **12/17/2004** | Date Released: **12/20/2004** | Date Closed: **OPEN** | Closed By: **N/A**

Work Description

The Mass Properties Measurement will measure and document the subsystem's weight.

Required Document

LAT-PS-04648

Hazards & Constraints

ESD Hazard
Suspended Load Hazard

Parts Description

CAL Tower Module
CAL Lifting Fixture Assembly
CAL Hoise Plate
CAL Handling Fixture Assembly
Handling Fixture Base Plate
Handling Fixture Post
Screw, Flange Socket-Head, M4 x 0.45 (20mm L)

Part Numbers

Work Order Number 01751

Serial Numbers

Event Listing for Work Order Number

WOA-1751

Event Number	Responsible Org.	Event Description	Perform By Date	Inspect By Date	PR Item#	Closeout By Date
010	NRL / QA	Notify QA of work start.	PVD 1-5-05	1/5/05	None	
☐ QA Witness						
020	NRL	Maintain as-run procedure with work order to record test data and attach the file as a PDF to this work order after completion of all steps and redlines.			None	
☐ QA Witness						
030	NRL	Maintain Quality Control in accordance with Section 5 of LAT-PS-04648.			None	
☐ QA Witness						
040	NRL	Perform Weighing Operation in accordance with Section 4.1 of LAT-PS-04648. Verify that all steps have been completed and all data has been recorded.	PVD 1-5-05	1/05/05	None	
☐ QA Witness						

Event Number	Responsible Org.	Event Description	Perform By Date	Inspect By Date	PR Item#	Closeout By Date

Support and Startup Requirements

Required Support:

- [x] QA Final Inspection
- [ ] Safety
- [x] Photo
- [ ] Logistics

Hardware and Other Support

CAL Lift Fixture

Shipping Container

Support Personnel:

Paul Dizon

Lisa Gelston

Lamont Franklin

Startup Requirements:

None

3 WEIGHT AND CENTER OF GRAVITY MEASUREMENT PLAN

Measurement of the mass properties for the CAL consists of the following operations:

- Weighing operation for all CAL Modules
- Center of Gravity measurement for one PEM

Because of the assembly flow, the CAL Module will never be in the complete CAL Module configuration until after it is assembled into the CAL Tower Module. Therefore, the weight and CG of the CAL Module cannot be measured directly. Weighing and CG measurement operations can only take place when the CAL is in various configurations during assembly, as shown in Figure 3-1.

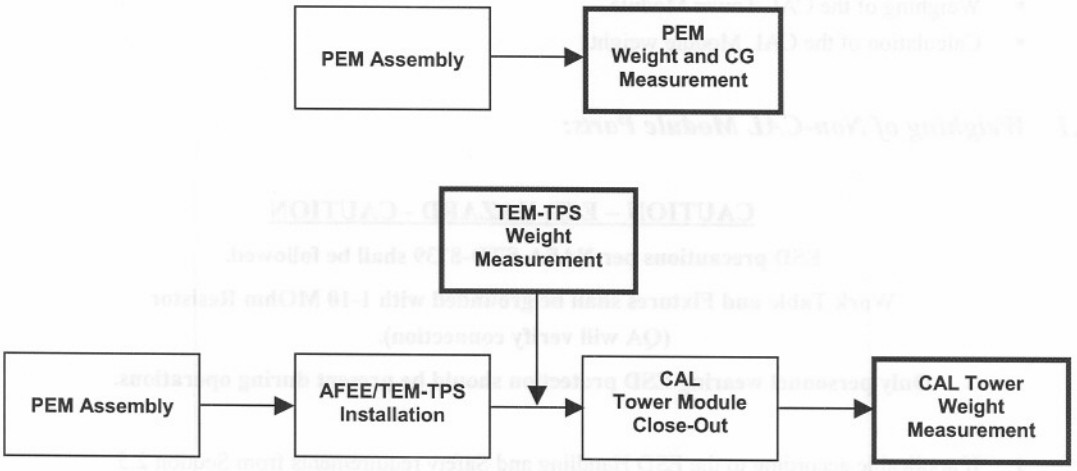

Figure 3-1: Mass Properties Measurement Flow

3.1 WEIGHING OPERATION

Because of the assembly flow, the weight of the CAL Module cannot be measured until after it is already assembled into the CAL Tower Module configuration. Since the weight of the CAL Module cannot be directly measured, all CAL Tower Module components that are not considered part of the CAL Module (Tower Electronics Module - TEM Power Supply Assembly and associated hardware) must be weighed before integration so that an accurate weight of the CAL Module can be determined.

3.2 CENTER OF GRAVITY MEASUREMENT

Because of the assembly flow, the CG of the CAL Module cannot be measured until the EM2 TEM-TPS is removed from the CAL Module. This event will not take place until after the CAL Module is delivered for integration into the Large Area Telescope (LAT). As a result, the CG of the CAL Module cannot be directly measured. However, it was determined that accurate CG measurements can still be measured when the CAL Module is in the PEM configuration due fact that: 1) the missing components only make up 2.5% of the total mass of the CAL Module and: 2) that these components are symmetrically located around the Z-Axis of the CAL Module.

4 PROCEDURE

Measurement of the mass properties for the CAL consists of the following operations:

- Weighing operation for all CAL Modules
- Center of Gravity measurement for one PEM

4.1 WEIGHING OPERATION

Weighing operations are divided into three seprate events:

- Weighing of the CAL Tower Module Parts not considered part of the CAL Module
- Weighing of the CAL Tower Module
- Calculation of the CAL Module weight

4.1.1 Weighing of Non-CAL Module Parts:

CAUTION – ESD HAZARD - CAUTION

ESD precautions per NASA-STD-8739 shall be followed.

Work Table and Fixtures shall be grounded with 1-10 MOhm Resistor (QA will verify connection).

Only personnel wearing ESD protection should be present during operations.

1. If applicable according to the ESD Handling and Safety requirements from Section 2.5
   - Verify that a certified grounding strap is connected to the associated electrical component.
   - Attach personal wrist strap to a common ground point.

2. Weigh the following items and record:

PART NUMBER	PART DESCRIPTION	S/N	QTY	WEIGHT (lb)
LAT-DS-00995	TEM-TPS Assembly		1	16.0
NA0069-060024	Screw, Socket-Head, M6 (24 mm)		4	0.037
A370-903-32	Washer, Flat, M6		4	0.001
			Total TEM-TPS Weight =	16.038

4.1.2 Weighing of CAL Tower Module:

The weight of each CAL Tower Module is measured as defined in the following procedural steps:

CAUTION – ESD HAZARD - CAUTION

ESD precautions per NASA-STD-8739 shall be followed.

Work Table and Fixtures shall be grounded with 1-10 MOhm Resistor (QA will verify connection).

Only personnel wearing ESD protection should be present during operations.

WARNING

During Lift Operations, a controlled area must be established to ensure that personnel are clear of the load at all times.

1. Verify that a certified grounding strap (with 1-10 MOhm resistor) is connected to the CAL Tower Module.
2. Attach personal wrist strap to ground.
3. Weigh the following MGSE items and record:

PART NUMBER	PART DESCRIPTION	S/N	QTY	WEIGHT (lb)
LAT-DS-04138	CAL Lifting Fixture Assembly (with fasteners)		1	16.5
LAT-DS-01524	Base Plate, Handling Fixture		1	11.8
LAT-DS-05952	Post, Handling Fixture (with fasteners)		4	4.7
			Total MGSE Weight =	33.0

4. Verify that PDU/GASU Cables have been disconnected from the TEM-TPS. Install ESD covers over the sockets if they are missing.
5. Attach CAL Lifting Fixture Hoist Plate (LAT-DS-02795) to the Top Frame of the CAL Tower Module using sixteen M4 socket-head cap screws. Tighten fasteners to 10 in-lb $\pm$ 1 in-lb.
6. Position the CAL Tower Module underneath the A-Frame or Hoist.
7. Attach CAL Lifting Fixture Assembly (LAT-DS-04138) to hoist.
8. Attach a second certified grounding strap to the Hoist Plate.
9. Disconnect the grounding strap from the CAL Tower Module.
10. Lower and attach the Lifting Fixture Assembly onto the Hoist Plate. Reduce the slack in the shackles, but do not load the hoist.
11. Verify that the scale is powered on and zeroed.
12. Lift the CAL Tower Module and slowly lower it onto the scale until Lifting Fixture Assembly is off-loaded. Disconnect Lifting Fixture Assembly from hoist.

13. Record the weight below.

    Weight = 238.8 lbs. = 108.3 kg

14. Lift the CAL Tower Module until it is clear of the scale.

15. Lower the CAL Tower Module into the shipping container per LAT-PS-04237. Attach ground strap to the grounding lug on the shipping container and remove the second ground strap from the Hoist Plate.

4.1.3 Calculation of CAL Module Weight

The weight of each CAL Module calculated using the following worksheet:

PART NUMBER	PART DESCRIPTION	WEIGHT (lb)
CAL TOWER MODULE (FROM SECTION 4.1.2, STEP 13)		238.8
TEM-TPS ASSEMBLY SUBTOTAL (FROM SECTION 4.1.1)		-(16.038)
MGSE SUBTOTAL (FROM SECTION 4.1.2, STEP 3)		-(33.0)
	Total CAL Module Weight =	189.76

(86.076 kg)